

CILS Research Framework

Aims and Purposes

The primary purpose of the Center for Informal Learning and Schools (CILS) is to strengthen the learning of K-12 science, mathematics, and technology. This aim will be achieved through undertaking research, consisting of both theoretical and empirical studies on informal learning, by improving professional practice in informal settings, and by increasing interactions between formal systems of education and informal science institutions.

Our work seeks to explore the nature of informal learning in a diversity of linguistic and cultural contexts and the appropriate instructional practices that might support such learning. In particular, we are interested in the contribution that informal learning might make to formal learning.

Our interest lies, therefore, in museums, science centers, families, and schools as sites of informal learning. In addition, another major aim of our work is to train and prepare the next generation of leaders in the field, either as researchers who will investigate the nature of informal learning, or as individuals who will become senior figures in science centers and museums. Our work seeks to build on the body of research that already exists, developing our understanding of how and when informal learning occurs.

The significant features of informal learning that distinguish it from formal learning are that learners choose, control, and collaborate in their own learning. Thus it builds on the learners' and their partners' interests with purpose or curiosity; and it provides freedom to determine and share both the goals and the means of any learning activity. Moreover, given the growing diversity, importance, and means of informal science communication, formal science education is increasingly drawn to the nature, principles, and practices of informal learning.

CILS researchers, doctoral and postdoctoral students are, therefore, examining the ways in which such informal learning processes and structures could enhance the learning of science and mathematics.

CILS' vision of informal learning is that it is more than a set of unstructured ephemeral experiences

outside of school. Rather, we believe that informal learning has a major and growing educational role in contemporary society in a growing number of contexts. Informal learning can offer experiences both within and out of school that enable learners to develop a deeper understanding of disciplinary content; recognize and comprehend the nature of scientific inquiry; appreciate the value of everyday understanding of science and mathematics; and provide unique and stimulating learning experiences that are informed by expert practitioners.

Addressing such aims requires an examination and exploration of the relationships between formal and informal learning contexts from social, cultural, cognitive, epistemic, and policy perspectives.

What are the major themes of the CILS research?

CILS' focus on existing practice and the design of interventions to promote more effective use of informal settings is concentrated on four overarching and interconnected themes:

- the means and structures of participating in informal learning
- the use of explanation, communication, and discourse in informal contexts in a range of settings
- the organizational structures, policies and agencies of those engaged in informal learning and their implications for practice
- learning environments and their design

These strands of theoretical and empirical research will, we hope, inform what is intended to be a major outcome of CILS, a better knowledge of the design of informal learning environments that will incorporate our best thinking and will promote student learning about science, mathematics, and technology. CILS intends to use knowledge generated about informal learning to strengthen its role and value in formal institutions, as well as to better understand the complex nature of learning that occurs in schools.

How will this work be approached?

The researchers engaged in this work bring a variety of conceptual lenses, all of which will serve to illuminate different aspects of the research tasks we have set for ourselves. These include exploring the nature of learners' activity and conversation; the epistemic commitments and assumptions that give rise to current practices and approaches; the development of communities of practice in which individuals, educators, teachers, and students work together to understand the nature of scientific endeavor; and the institutional and cultural traditions that shape the nature of people's engagements with informal learning.

CILS Research Themes

1. *The Means and Structures of Participation in Informal Learning*

The research on participation examines how social interaction is sequenced and organized in recognizable patterns, such as how turns to speak are regulated, or how collaborative learning is orchestrated. For example, a structure that is common in schooling is for the teacher to manage and control the opportunities for student talk. Commonly the teacher will initiate dialogue with a question to elicit a student response which, in turn, is followed by an evaluative response from the teacher. The cycle then repeats and the interaction is solely between teacher and the student with little opportunity for student-student interaction. However, there is a large body of research that shows the authoritarian nature and structure of such discourse limits the role and value of dialogue in the learning of science.

Our belief is that the practice of science education in classrooms would be enriched by alternative models of participation. For instance, the

structure of interaction commonly seen in a variety of informal learning scenarios is much more conversational, permitting student initiated questions and the critical evaluation of argument. Such a form of discourse is encouraged by apprenticeships, inquiry in and around exhibits, collaborative problem solving, and "intent participation." In the latter, experienced people play a guiding role, encouraging learners' involvement. Often they participate alongside learners—for example, a mother showing her child how to cook, or a parent helping an adolescent learn how to drive. In such situations, the learner takes the initiative in learning and contributes to a shared endeavor of importance to their social group, sometimes offering leadership in the process. Intent participation involves learning information or skills in the service of accomplishing socially valued goals such as learning to use a new computer program in order to create a classroom newspaper desired by the class.

Our theoretical focus and interest in such "structures of participation" also encompasses the ways in which forms of participation and learning become institutionalized in the structures and procedures of groups such as families, museum educators, and other "communities of practice." Moreover, we are interested in how these forms of participation embody historical, cultural, and epistemic practices of communities. Thus research here may examine the structures that facilitate informal learning in diverse communities, the nature of users' interactions with exhibits, and the structures that facilitate collaborative educational partnerships between schools and other communities [Example 1]. Those researching participation may also examine how interventions in the structure of participation affect learner motivation in informal settings.

Example 1

A pressing issue that faces science and math education in the schools is how to reach the growing proportion of students whose families have little history of schooling. Currently, about 70 percent of the students in the 100 biggest school districts in the US are African American, Latino, and Native American children, and their families often have relatively little history of schooling. The science and math curriculum is often especially inaccessible to these students.

Research indicates that attention to the participation structures of informal learning can help to engage these students (and the others too!) in science and math, developing their interest and expertise. Many of the students, coming from communities where schooling has not been prevalent, have experience and great success in learning situations that are structured informally. One key aspect of a successful structure is a collaborative arrangement between adults and children, where children are expected to contribute to the direction of an activity in which adults are involved as well. Another aspect is having a clear purpose for the activity that is valued (or even chosen) by the children, with clear steps to the goal for all participants. These features of informal learning involve a structure of participation that contrasts with the formats that often prevail in schools, but some schools employ informal structures, with success for students of color as well as mainstream students. CILS research examines contrasting structures of participation that are traditional in schools as well as those in other institutions and in communities where schooling has not been prevalent.

This focus on "participation" enables the advancement of a principal concern that underpins much CILS research—that is an analysis of the highly flexible and contingent forms of interaction that arise within informal learning of individuals, classrooms, groups, institutions, and organizations, and its contribution to learning. In addition, we are interested in how practical interventions in these institutions and organizations serve to preserve or initiate particular patterns.

Finally, this particular lens of participation also enables important structural investigations. With the goal that the design of exhibits and informal learning environments engage or interest a greater range of social groups, studies could consider how more design approaches might be developed.

2. Explanation, Communication, Discourse

Research has begun to tie the learning of science and mathematics to the nature of the discourse, both in and out of classrooms. From this perspective, language is an essential tool for creating scientific explanations, arguments, narratives, metaphors, and analogies. Through language and discourse people explore and convey scientific and mathematical ideas. When learners engage in constructing and communicating explanations, whether they be scientific claims, mathematical conjectures, theories, interpretations, or representations, they are forced to externalize, clarify, and restructure their knowledge. It is this process that stimulates individuals' understandings and presents opportunities for learning.

For these reasons CILS' research includes studies of the role of explanatory conversations between individuals (e.g., parents-children, children-children) in out-of-school settings to investigate the developmental processes in scientific understanding. The rich and complex settings offered by out-of-school contexts enable us to examine the manner in which argument and explanation are enabled, and scaffolded, by peers, exhibits, and technology. Another focus of interest here is the potential of narrative as a mode of communicating science in both formal and informal contexts.

By examining the nature of conversations and explanations—and the ways in which those are constructed and communicated—we hope to develop an understanding of the impact on learning of particular forms of discourse. In addition, we hope to learn how exhibits, texts, and scientific and historical artifacts can promote discourse and shared engagement. A fundamental premise in looking at forms of discourse is that small, everyday social interactions accumulate to greater consequences for learning about science and mathematics.

Hence, by studying *what* is explained, by *whom*, to *whom*—that is, in what ways, under what circumstances, and with what evidence—we hope to gain deeper insights and understanding of the potential of informal contexts to promote learning. In particular, we are interested in what permits, or inhibits, particular types of conversations to occur within different contexts and institutions.

Example 2

Many informal science institutions offer discourse-based events for their visitors. My research interest lies in the delivery and benefit of these programs for learning. Relying on the research that has been used to promote science understandings through discussion and argumentation within the school classroom structure, what kind of learning and engagement do these programs develop for the individuals and families that visit? This research plans to examine ways in which discussion-based activities (stand-alone or added to existing activities) enhance programs in informal science institutions and how this may improve science learning.

3. Systems and Structures That Support Informal Learning

Our study here is on organizational systems and structures of informal science institutions. While schools and informal science institutions are both educational institutions, they have different pasts, organizational structures, management practices, histories, and traditions. This third focus seeks to investigate the political landscapes, decision-making processes, leadership models, and everyday practices that prevail in informal museums, aquaria, and science centers, as well as in after-school programs, community organizations, and families.

Understanding how to make an informal science institution a learning organization both for itself and for schools requires an examination of the belief systems, policies, institutional relationships, and mechanisms that exist in informal learning systems and K-12 institutions. Essential questions include what kind of learning is valued and what is the conceptualization of learning itself? How do they differ between and within institutions?

Answers will hopefully reveal the values that underlie decisions of both the institutions that arrange, manage, and evaluate learning, and the people who interact with learners. The insights gained will enable us to identify those practices that support learning.

Improvement in K-12 instruction also requires understanding the processes of organizational change and making explicit those structures to a diversity of stakeholders (teachers, administrators, funders, voters, legislatures)—in particular, the forms and models that successfully enable innovative designs, robust learning, and effective instruction to occur. The process also requires identifying the principles and characteristics of such programs and practices. In addition, the political and economic issues that surround decision-making about opportunities and environments for children's learning are key aspects for investigation here and, in turn, the promotion of effective learning organizations and partnerships.

Example 3

Museums, science centers, and schools are quite obviously very different kinds of places. Uniting these established institutions in a common purpose is not particularly easy. Each "world" has developed its own ways of doing things, and outsiders may not comprehend those practices. Museums employ educators who serve as liaisons with schools. If the museum is a "community of practice," that is, a group of individuals engaged in a joint enterprise who share a repertoire of ways of doing things, have a common understanding of the nature of their work, and together have an identity as belonging to the museum world, then the job of these museum educators is to broker interaction between the two worlds. This study will carry out a limited ethnographic study of museum educators—that is, observe and participate in their work for an extended time (several months at least). In particular, the study is interested in the brokering function, as well as what are termed "boundary objects,"—that is artifacts (such as exhibits) that are particularly effective in helping to bridge the gap between schools and museums.

This research will be collaborative; that is, it will work with museum educators to answer questions they might have about their work with schools. Very often busy people have little time to reflect and think critically about their work, and participating in this research will provide them that space. The overall purpose of the study is to add to our understanding of ways in which schools and museums can work together.

4. Learning Environments and Their Design

In the 1999 National Academy of Science's report *How People Learn*, substantial attention was paid to the importance of the implicit and explicit design of learning environments. Drawing on the expertise of the CILS partners and using the research themes, we are examining the designs for learning in informal science institutions for science and mathematics. In addition, we hope to explore intentional and experimental interventions that may lead to effective change.

Learning environment design looks at creating "usable knowledge"—knowledge that can inform the design of educational innovations and, as a corollary, improve educational practice. Our inquiry here is tied to a "theory of action" that sees research about practice as a process conducted for, by, and with practitioners, in a partnership that involves researchers and practitioners working closely on the same learning problem in the same setting.

Our work here will explore the design of information, new media designs, exhibits, curricular materials, simulations, and other representations and learning tools. For example, why does a learner's conception of science phenomena (such as how a light bulb works) change when the information is represented by a photograph versus a schematic drawing? Design of learning environments also examines the design of effective inquiry-based activities and professional development programs that might support rich, epistemic understanding of science and mathematics.

A goal is to generalize the results of research that takes place in one context for use in new contexts, whether from that of a museum to that of a school, or from one classroom to multiple school classrooms. Our aim is to help understand how innovative designs for education can help us develop better theories of learning *and* better educational practice.

In approaching this work, we will explore different spatial and temporal arrangements for exhibits, instructional formats, and modes of interaction. Our interest lies in the relationships that may or may not exist between the design of assessment, opportunities to learn, and the development of an individual's understanding and skills.

Example 4

My work examines the nature of social interaction and talk that occurs between students and Explainers within Investigate—the hands-on gallery in The Natural History Museum, London. My particular focus is on the support provided by the Explainers for scientific reasoning and reflective discourse in a space that while rich in stimuli, scientific tools, and reference materials, offers little in the way of structured guidance.

To support the development of scientific reasoning, I am working with the Explainers on a series of interventions designed to help students to adopt scientific practices and construct scientific explanations. The interventionist strategy follows a design-based research methodology whereby Explainers are encouraged to develop and refine interventions to their existing practice whilst evaluating the impact on the students' behavior. My research thus articulates CILS view of research as a partnership between researcher and practitioner in order to improve educational practice.

This research also resonates with the theme of "participation" in that the analysis of the explainer-student discourse, before and after the practical interventions, will serve to describe the types of interaction that arise within informal learning institutions, and thus highlight particular patterns that foster learning.

Summary

To conclude, the work of CILS researchers, doctoral and postdoctoral students, is a unique opportunity to participate in a cross-institutional research program supported by a partnership of faculty, researchers, practitioners, scientists, artisans, and other CILS participants who endeavor to understand how informal science institutions can support and improve K-12 schooling and schools. We hope the outcomes of our work will be research that contributes to the following:

- improved informal learning in informal settings
- more informal learning in formal settings
- improved use of formalized learning in informal settings